CHAPTER 16

THE INTENSIVE CARE MANAGEMENT OF PATIENTS WITH COVID-19

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INTRODUCTION

Coronavirus Disease-19 (COVID-19) has become a serious health problem since it was first defined in Wuhan, China in December 2019 and it has also given rise to a global crisis in all its economical, sociological and psychological aspects. Consequently, World Health Organization (WHO) declared this epidemic as a pandemic on March 11,2020. Besides its being severely infectious, the most feared aspect of this disease is that it causes serious pulmonary infection in almost 20% of the patients and it requires intensive care and respiration support for 5-10% of these patients. Therefore, the primary and most important factor determining mortality in countries is the healthcare system and that the resources meet the demands especially with the limited number of intensive care beds. During this process, the most important duties of health practitioners are on one hand to fulfil the increasing demands and on the other hand to follow scientific literature along with clinical and experimental studies every day and to benefit from the experiences of clinicians dealing with pandemic all over the world. Since there are limited studies about COVID-19, recommendations for treatment were generally acquired from the experiences in China, Italy, the USA and the UK. In this section, we aimed to summarise the essential points in the intensive care management of the patients with COVID-19.

ICU INFRASTRUCTURE

Suspected or confirmed COVID-19 intensive care patients should be followed in airborne infection isolation room (AIIR) with negative pressure so as to protect other patients and healthcare professionals. However, it was determined in a survey carried out in 335 intensive care units (ICUs) in 20 Asian countries that only 12% of the rooms were AIIRs. Therefore, the patients could be taken into single rooms that are ventilated enough in ICUs without AIIRs. In an another survey conducted in Asia, it was stated that only 37% of the available rooms in intensive care units were single rooms and 13% of intensive care units did not have single rooms. The number of single rooms and AIIRs are highly low generally in the low-income countries. Cohort intensive care could be considered as an alternative in places where single intensive care rooms do not exist. Available evidence suggests that even if COVID-19 infection transmits through droplets rather than air, concerns about nosocomial infection in cohort intensive cares continue especially when aerosol-generating procedures are carried out. Therefore, personal protective equipment (PPE) should be taken into consideration for the patients in shared rooms. Oxygen masks with HEPA filter could provide even a little protection for the patients who are not intubated.

ICU Staffing

It is known that high workload of intensive care staff is in closely associated with high mortality. So, the number of the staff should require to be increased with the staff from other ICUs or other departments except ICU. It is quite significant the staff recruited from other departments should be trained about intensive care management and especially COVID-19 protocols. The risk of being infected with SARS-CoV-2 should be taken into account for intensive care unit staff. It is important to minimise the infection risk because not only does it directly cause the loss of manpower but also it has a devastating effect of being infected on morale of the staff. Mental health problems such as depression and anxiety are more common among healthcare professionals in intensive care units due to the constant fear of being infected and difficult workload. Measures should be taken to prevent these kinds of problems. For this purpose, the necessary support should be given in order to prevent the spread of the infection, to communicate with the administration of the hospital and ICU doctors, to limit shift hours, to provide resting areas if possible and to relieve the staff with a multidisciplinary team including psychiatrists and psychologists.

ICU capacity

It is difficult but possible to take the spread of COVID-19 under control in the society and it is highly significant to maintain the capacity of intensive care. National and regional modelling of the requirement for intensive care is quite important. Let alone isolation or single rooms, many countries could not have sufficient intensive care beds at first stage. Most of the countries cannot show success in building new hospitals or intensive care units as China did in Wuhan during COVID-19 pandemic. The increases in the number of critically ill patients with COVID-19 could be sudden and rapid; therefore, ICU doctors, hospital administrators and governments should do planning for the increase in the capacity of intensive care beds in advance. Although it is possible to add beds to available intensive care units, the risk of nosocomial infection limits this choice as a result of the contraction of existing area. Converting the areas except the available intensive care into intensive care units and transfer of the patients to other determined hospitals and ICUs are among the other choices. Though centralising the resources and experts increase the result and efficiency, these benefits should be considered well against the risks during the transfer of the patients among hospitals. The fact that being dependent on a few centres could not solve the problem in case of the rapid increase in the number of patients during pandemic should also be taken into consideration. Gradual increases in ICU capacity also requires the increase in the number of not only beds but also equipment, consumables, medicine and staff. To reduce the density in ICUs, elective surgeries should be postponed and the patients with lower-acuity should be transferred to other departments for the treatment of the patients with COVID-19 who will need isolation.

ICU triage

If intensive care beds become in short supply for COVID-19 patients in despite of the strategies that will be carried out in intensive care, the necessity to apply triage in intensive care units could arise for these patients. This situation is valid for patients with and without COVID-19 since both groups can need the same ICU at the same time. Triage in intensive care unit is an ethically complex and emotionally devastating process. The ideal thing is its being coordinated by national or regional healthcare systems. Some countries published guidelines for such cases during COVID-19 pandemic. Extensive physiological result-prediction scoring systems could be misleading in predicting the course of the disease. For old patients with comorbidity in COVID-19, it was determined that the results were worse in high D-dimer and C-reactive protein concentrations and the number of lower lymphocyte.

GENERAL CHARACTERISTICS OF COVID-19 PATIENTS ADMITTED TO INTENSIVE CARE

The criteria for admission to intensive care unit may vary according to countries and institutions. The patients' needs for ICU varies between 5-32%. Severe disease could emerge with the symptoms of severe acute respiratory infection (SARI) and it is stated that 60-70% of these patients could have severe pneumonia and acute respiratory distress syndrome (ARDS); 30% could have sepsis and septic shock, 20-30% may have myocarditis, arrhythmia and cardiogenic shock and acute renal failure may develop in 10-30% of them.

Although respiratory failure is often hypoxemic, hypercapnic respiratory failure mainly results from mucus plugging. It is indicated male gender is more with M/F ratio of 2/1 in severe cases. Moreover, according to the recent data in Italy, the ratio of male gender was determined to be 82%. Though hypertension and diabetes are the most frequently reported comorbidities, advanced age is also a risk factor for the development of severe disease. The duration between the onset of clinical symptoms and the development of pneumonia is almost 5 days and the time for admission to ICU after the development of hypoxemia is 7-12 days. The mortality rate due to COVID-19 in ICU is stated as 16-78% in various studies. In latest multicentre studies in Italy, the mortality rate was reported to be 26%. Advanced age, hypertension, diabetes, cardiovascular disease, chronic pulmonary disease, cancer, high D-dimer and C-reactive protein, low lymphocyte levels were found to be related to high mortality.

SEVERITY OF DISEASE AND INDICATIONS IN ADMISSION TO INTENSIVE CARE

The patients with severe pneumonia in COVID-19 disease are taken into intensive care and followed.

Severe forms of the disease:

- Severe pneumonia,
- Acute respiratory distress syndrome (ARDS),
- Sepsis,
- Septic shock,
- Myocarditis, arrhythmia, cardiogenic shock,
- Multiple organ failure tables,

Severe pneumonia

The patients in this group come up with radiological and laboratory findings accompanied by such symptoms as fever, dyspnoea and cough. These are the patients with respiratory distress symptoms like tachypnea with a respiratory rate of >30 /min, use of accessory respiratory muscles and thoracoabdominal respiration and with oxygen saturation (SpO_2) <%90 in the room air or with PaO2/FiO2 ratio of <300. The course of COVID-19 pneumonia is severe in the patients with comorbidity and decompensated heart failure and chronic pulmonary disease exacerbation could accompany the table in these patients.

ARDS

ARDS that may occur in patients with severe pneumonia and progresses with a high mortality is defined according to the criteria below:

1. Respiratory distress which has occurred or got worse for the last week
2. Bilateral opacities that cannot be explained with radiologically volume overload, lobar or pulmonary collapse or nodules
3. Inexplicability of respiratory failure alone with heart failure or fluid overload
4. Hypoxemia
   a. Mild ARDS: 200 mmHg< PaO_2/FiO_2 ≤300 mmHg (PEEP ≥5 cmH_20)
   b. Moderate ARDS: 100 mmHg< PaO_2/FiO_2 ≤200 mmHg (PEEP ≥5 cmH_20)
   c. Severe ARDS: PaO_2/FiO_2 ≤100 mmHg (PEEP ≥5 cmH_20)

Sepsis

This is the syndrome in which suspected or confirmed infection is accompanied by the symptoms of organ failure. To determine the symptoms of organ failure, Sequential Organ Failure Assessment (SOFA) score is suggested. A suspected or confirmed infection is defined as sepsis when there is an increase rate of ≥2 in SOFA score.

Septic shock

This is the vasopressor need in sepsis patients due to persistant hypotension to fluid treatment (<90 mmHg systolic blood pressure, >40 mmHg decrease in normal systolic blood pressure or <65 mmHg mean arterial pressure); and blood lactate level is over 2 mmol/L.

Besides the fact that severe pneumonia, ARDS and sepsis are the main clinical forms for COVID-19 in intensive care, it should also be remembered that multiple organ failures such as arrhythmia, myocarditis, kidney and liver function disorder, thrombocytopenia and confusion could emerge.

MONITORIZATION AND LABORATORY

COVID-19 is a multisystem disease affecting notably the respiratory system, cardiovascular, renal and gastrointestinal and even central nervous system. Therefore, clinical and laboratory monitarization requiring close follow-up of all systems is of great importance during the intensive care follow-up of the patients with the disease. Monitarization methods according to severity of the disease, involvement of the systems, accompanying comorbidities could be carried out with a broad extent from non-invasive to invasive. In addition to standard monitoring techniques, end-tidal CO_2 measurement and constant follow-up of body temperature should be done for the patients having serious respiratory failure on mechanical ventilator. If severe pneumonia, sepsis, septic shock and cardiac failure are accompanied with hemodynamic failure, monitoring dynamic parameters measuring cardiac output through invasive and non-invasive methods is of great importance. Echocardiography and pulmonary ultrasonography are also important clinical tools to guide the treatment. Arterial blood gas measurement includes very valuable parameters about tissue perfusion, fluid, sepsis, septic shock management and about oxygenation, ventilation, acid-base balance, blood lactate level and therefore ensuring the management of respiratory support of the patient appropriately. Measurement of advanced procalcitonin values should represent that bacterial infection could have been added to the table. Distinct increases in AST level in serious COVID-19 cases is associated with mortality. The kidneys are the organ system that should be closely monitored for possible perfusion disorders during critical disease and shock processes as well as being another organ containing ACE receptors affected by coronavirus. The incidence of probable renal failure in these patients has increased. In terms of cardiovascular exposure, EKG and troponin and ProBNP monitoring could be useful for patients. Coagulation parameters are important in terms of following the clinic of secondary haemophagocytic lymphohistiocytosis(HLH) and processes like coagulopathy and vasculitis that could develop in these patients. PT, APTT, Fibrinogen, D-dimer and ferritin monitorization are suggested. As bronchoscopy increases infection risk during diagnosis, tracheal aspiration samples, bronchial or bronchoalveolar lavage should be preferred.

RESPIRATORY SUPPORT

Early diagnosis of hypoxemic respiratory failure is significant. In despite of conventional oxygen therapy, increase in respiration and hypoxemia could get worse progressively. Oxygen support should be given with low-flow oxygen delivery systems (nasal cannula, simple face mask, non-rebreather mask). Venturi and diffuser masks should be avoided as they can cause oxygen toxicity. High Flow Nasal Cannul (HFNO) and non-invasive mechanical ventilation (NIMV) support could be applied to the selected patients with hypoxemic respiratory failure. However, hypoxemia and tachypnea do not improve in the first few hours, these patients should be monitored closely in terms of clinical deterioration. It should not be applied to the patients who cannot control NIMV secretions, have a high aspiration risk and impaired mental status, are not hemodynamically stable and have multiple organ failure. Prolonged spontaneous ventilation could lead to a similar damage to pulmonary damage caused by ventilator by increasing negative intrathoracic pressure in these patients. Therefore, this should be prevented by performing endotracheal intubation as soon as possible. Invasive mechanical ventilation is required for almost 10% of these patients need. Endotracheal intubation should be applied by trained people by using rapid-sequence intubation protocol. If possible, intubation should be performed with video-laryngoscope. Intubation with flexible bronchoscopy carries a high risk of aerosolisation. Balloon-mask ventilation should be avoided during preoxygenation. Preoxygenation could be applied through non-rebreather masks. If it is needed to use balloon-mask, filter should be used. Neuromuscular blockers could be applied in order to suppress the cough before intubation. Positive-pressure ventilation should not be started before inflating the cuff of endotracheal tube. Closed system suctioning methods and bacteria-virus exchanger filters (HME) could be used. If it is not strictly required, bronchoscopic intervention should be avoided and metered dose inhaler (MDI) should be used instead of nebulizers for bronchodilator therapy.

For patients with ARDS, low tidal volume (4-6 ml/kg), low inspiratory pressure (plateau pressure <30 cm H_2O) and <14 cm H_2O driving pressure should be performed. Deep sedation can be necessary to reach target tidal volume. In cases of pH <7. 15, tidal volume can be increased up to 8 ml/kg. In addition, permissive hypercapnia should also be allowed when needed. If there are no symptoms of tissue hypoperfusion, conservative fluid therapy should be applied. PEEP titration should be carried out at pressures which will prevent atelectotrauma and excessive distention. There are no available data for recruitment manoeuvre. If there are ventilatory dyssynchrony, resistance hypoxia and hypercapnia in patients with mild and severe ARDS in spite of deep sedation, neuromuscular blockers could be used in the first 24-48 hours of mechanical ventilation. For patients who have the value of PaO_2 / FiO_2< 150 and were applied conventional mechanical ventilation, prone position could be performed for more than 12 hours. It has been suggested that prone position is also useful for the patients who are not intubated and can spontaneously inhale. Routine use of corticosteroids is not suggested. Extracorporeal membrane oxygenation (ECMO) could be taken into consideration for the patients with refractory hypoxemia in despite of lung-protective ventilation and eligible patients should be transferred to experienced centres. Due to lack of evidence about this virus and disease, the advantage of ECMO is not clear. There are also studies stating that ECMO is not a frontline therapy method considered in case of major pandemic.

There are 2 phenotypes of respiratory failure in COVID-19 patients. In the phenotype characterized with low elastance (high compliance) and called Type-L, the perfusion rate, lung weight and recruitability are low. In the phenotype characterized with high elastance (low compliance) and called Type-H, right-left shunt fraction, lung weight and recruitability are high. Severe hypoxemia in lungs with high compliance could be explained by the loss in lung perfusion regulation and hypoxic vasoconstriction; increasing FiO_2 could be a solution to hypoxemia in these patients. Early intubation can cause transition to Type-H. In addition, in patients who are intubated and have hypercapnic Type-L, ventilation from 6 mL/kg to 8-9 mL/kg does not lead to the risk of pulmonary damage induced by ventilator. However, performing high PEEP for the non-recruitable lungs in Type-L patients could cause hemodynamic deterioration and fluid retention. Type-H phenotype is similar to moderate ARDS; therefore, high PEEP, prone position and even extracorporeal support are among the conventional therapy methods to choose. These suggestions have not been proved by large-scale studies and in severe hypoxemia, delaying intubation and increase in respiration could make the situation worse. In patients who do not respond to conventional O_2 therapy, early intubation or short term NIMV and HFNO are suggested. It should be ensured that the need for oxygen has reduced ($FiO_2 < 40$, PEEP < 8 cmH_2O), the patient is hemodynamically stable and conscious and cough reflex has been maintained for weaning. Instead of T-tube weaning trials, weaning with pressure-assisted ventilation could be preferred as it emits less aerosol. It is also not clear whether cuff-leak test will be carried out in weaning. In patients with weaning failure, tracheotomy indication accepted as a high-risk procedure for aerosolization could occur.

COAGULOPATHY AND VENOUS THROMBOEMBOLISM

In the studies carried out, coagulopathy has been found to be associated with mortality and it has been suggested that mortality significantly decreased by heparin utilization in patients with COVID-19. As well as anticoagulant effect of heparin, it has been shown that binding inflammatory cytokines, inhibiting neutrophil chemotaxis and leucocyte migration, sequestration of acute-phase proteins through peptide C5a neutralization play role in decreasing mortality. Therefore, though thromboprophylaxis is not a specific therapy to COVID-19, when pathophysiology of the disease is taken into account, it is considered to be important. Low molecular weight heparin (LMWH) is used as prophylactic in intensive care units. Microvascular thrombosis due to increased endothelial injury may develop in COVID-19 patients. Increased fibrinogen and D-dimer levels and hypercoagulability also increase depending on the severity of the disease. The risk of pulmonary embolism development is considered to be high for these patients. So, it is required to apply LMWH to every patient in prophylactic dose and to patients with high risk of clinical thrombosis at therapeutic dose.

- thrombosis prophylaxis in patients with D-dimer <1000 ng/ml
- CrCl>30 ml/min.
  - BMI <40 kg/m^2 Enoxaparin 40 mg/day subcutaneous
  - BMI >40/kg/m^2 Enoxaparin 40 mg 2 × 1 subcutaneous
- CrCl<30 ml/min.
  - As low molecular weight heparin is not generally suggested, standard heparin 5.000 U subcutaneous 2 × 1 or 3 × 1 can be applied.
- the patients with D-dimer >1.000 ng/ml or severe disease
- CrCl>30 ml/min.

  - Enoxaparin 0,5 mg/kg subcutaneous in every 12 hours
- CrCl<30 ml/min.
  - Standard heparin 5.000 U subcutaneous 2 × 1 or 3 × 1 or reduced dose low molecular weight heparin are suggested.

FLUID MANAGEMENT AND RENAL REPLACEMENT TREATMENT

When the patients apply to the hospital for COVID-19 symptoms, they are generally on the 7-14th day of the disease and they may be dehydrated. A careful fluid evaluation is required for all the patients when applying to hospital because preload response such as passive leg raise test should be considered given the high incidence of myocardial dysfunction in COVID-19. The reason for myocardial dysfunction is thought to result from strong binding affinity of SARS-CoV-2 spike protein to human angiotensin converting enzyme 2 (ACE2). The findings of troponin, beta natriuretic peptide concentrations and echocardiography are important for the early detection of myocardial involvement. Conservative or resuscitative fluid management strategy and administration of inotrope or vasopressors should be accordingly decided. It could be more useful to avoid from excessive positive fluid balance instead of targeting negative fluid balance in the early period. Negative fluid balance is especially aimed for the patients with ARDS. It has been shown that conservative fluid strategy improves oxygenation and increases the number of days spent without ventilator. This situation could be ensured by diuretic treatment; however, in some cases, renal replacement therapy can require to be started so as to get negative fluid balance. Such electrolytes as sodium, potassium, magnesium and phosphate should be kept at their normal values. In spite of appropriate fluid replacement, the first preferred vasopressor agent is norepinephrine for the patient with hypotension (<65 mmHg mean arterial pressure). Norepinephrine with the dose of 0.05 mcg/kg/min. when mean arterial pressure is over 65 mmHg is administered and could be increased when necessary. Alternative agents except noradrenaline should be vasopressin or adrenaline. It can be necessary to reduce noradrenaline dose so as to minimise the possible side effects during high-dose noradrenaline use and in this case, vasopressin is recommended. Dobutamine could be involved in the treatment for the patients with hypotension and symptoms considered as cardiac dysfunction.

Conventional indications to start renal replacement therapy are hyperkalaemia, refractory acidosis, uraemia and fluid overload. Renal replacement therapy could also be performed for patients with COVID-19 and acute kidney injury to provide negative fluid strategy. In COVID-19 patients who have been performed renal replacement therapy, there is anecdotal evidence suggesting that the frequency of filter thrombosis is more though known anticoagulation methods are used in filter circuit; therefore, the use of continuous systemic unfractionated heparin infusion should be considered instead of citrate and/or low molecular weight heparin (LMWH) for anticoagulation in COVID-19 patients to be operated renal replacement therapy. It is stated that anti-Xa measurements are more reliable than APPT in order to evaluate the efficiency of UFH in preventing filter thrombosis.

PHARMACOLOGICAL TREATMENTS IN COVID-19 DISEASE

Supportive care is the essential point of intensive care management of COVID-19 patients. Very few of pharmacological operations are evidence-based. Researches in this field continue today.

Antivirals

Early use of favipiravir considered more secure than other antivirals in terms of side-effect potential and drug interactions is suggested for the patients with severe pneumonia. 2x1600 mg favipiravir loading and 2x600 mg maintenance treatment are recommended.

Remdesivir is an RNA-dependent polymerase inhibitor and adenosine analog blocking a viral replication. FDA has allowed remdesivir use in children and adults with severe COVID-19 in the USA. Studies on its efficiency in treatment continue. Although preliminary results present its possible efficiency in COVID-19 patients, the knowledge about selection of patients have not been clear yet. Remdesivir is not suggested for patients with five times more alanine aminotransferase (ALT) level than the normal level. If ALT level exceeds this value, the drug should be discontinued. The drug should not be administered to the patients with GFR <30 ml/min.

Antimicrobial treatment

Routine antibiotics use is not recommended for uncomplicated COVID-19 patients; however, since the diagnosis of COVID-19 takes time and the distinction of the disease from other bacterial and viral pneumonia is difficult, empirical antibiotics are frequently used. In addition, as atypical community-acquired pneumonia will develop in most of the patients, antibiotic treatment will be administered to these patients. Antibiotic requirement should be checked daily and discontinued if it is culture-negative. In intensive care units, the participation of microbiologists is suggested for multidisciplinary approach.

Steroid treatment

Corticosteroids, especially dexamethasone and hydrocortisone, are frequently used in the management of COVID-19 patients

WHO has two suggestions regarding corticosteroids;

1. A strong suggestion for systemic corticosteroid therapy (intravenous or oral) for severe or critical COVID-19 patients
2. A conditional suggestion about not performing corticosteroid therapy in COVID-29 patients who are not acute.

Dexamethasone and hydrocortisone should be applied for severe or critical COVID-19 patients in cases below;

1. Acute respiratory distress syndrome (ARDS)
2. Sepsis or septic shock
3. In other cases needing supportive therapies like ventilation or vasopressor therapy
4. In cases with severe respiratory distress
5. In patients with O_2 saturation of < 90 in room air
6. Increased respiratory rate (> 30 /min)

Dexamethasone may be discontinued if the patients are to be discharged from the hospital in 10 days. For the patients who could take them orally and who are not considered to be of great concern with enteral absorption, oral tablet forms should be given. Intravenous administration should be used only when tablet or oral solution is not appropriate or available. While prescribing dexamethasone, it should be paid attention to the effect of proton pump inhibitors on protecting gastric ulcer. Hydrocortisone could be performed 50 mg intravenously three times a day for 7-10 days. Administration of it with a low dosage for longer time could be considered for the patients with septic shock.

Treatment for Cytokine storm

Makrophage activation syndrome (MAS) or secondary haemophagocytic lymphohisitocytosis (HLH) is a hyperinflammatory syndrome that may progress to fulminant multiple organ failure and could develop in the course of severe infections as well as rheumatic diseases, as a result of excessive release of pro-inflammatory cytokines such as IL-6. Among the clinical and laboratory findings are persistent fever, serious elevation in acute phase reactants like CRP, hepatosplenomegaly, cytopenia, hypertriglyceridemia, hyperfibrinogenaemia, increased AST, increased ferritin, haemophagocytic syndrome in bone marrow aspiration or biopsy and immunosuppression. They are seen in almost 5% of the critical patients and these patients should be treated in intensive care units. It is indicated that steroid, intravenous immunoglobulin (IVIg), Tocilizumab, Anakinra and JAK inhibitors could be used in treatment. However, it should be taken into consideration that these drugs have significant side effects in terms of intensive care. First, they could cause immunosuppression. High-dose corticosteroids are not recommended for COVID 19 patients except specific cases mentioned above. Since IgA deficiency is a contraindicated situation for IVIg, it is suggested to be administered by looking at IgA level in IVIg treatment. Moreover, it is stated that, with IVIg, there are risks of anaphylaxis, aseptic meningitis, pulmonary damage associated with thromboembolism and transfusion, overload symptoms, acute renal failure and hyponatremia. Even though administration of 400 mg IV Tocilizumab and its repetition in 12-24 hours are recommended, it should be remembered that in patients with the history of diverticulitis, a picture similar to ARDS could cause gastrointestinal perforation. Pregnancy is contraindicated in neutropenia ($<500/mm^3$), active tuberculosis, active hepatitis B or C, allergy and hypersensitivity.

There is no clear evidence about the use of extracorporeal treatments based on the removal of cytokines in Covid-19 pneumonia. A specifically processed type Oxiris that is also used as Sepsis adsorption column HA380 (Jafron© Biomedical Co., China), Cytosorb© sepsis column (CytoSorbents Corporation, NJ, USA) and AN-69 membrane sepsis column are extracorporeal cytokine removal methods that could be used. However, its efficiency in COVID-19 patients is not known. Whereas therapeutic plasma exchange may be used in removal of cytokines in patients with sepsis, it is not recommended routinely in COVID-19 pneumonia. All these practices have not been included as evidence-based in manuals but they have been recommended in case studies more. In addition, in patients developing hemodynamic renal failure requiring continuous renal replacement therapy, it should be kept in mind that cytokine removal can be performed through filters having sepsis column features and a protocol including a convection method. Intensive care management of COVID-19 patients are summarized in **Figure 1**.

CARDIOPULMONARY RESUSCITATION (CPR)

In case of cardiac arrest, CPR should be carried out by the people with personal protective equipment. Chest compression or airway procedure should not be performed without wearing full personal protective equipment. Chest compression in CPR should be started with automatic resuscitators if possible. Pre-oxygenation could be employed by non-rebreather masks so as to avoid aerosol contamination. If pulsatile rhythms are diagnosed and intervened as soon as possible, circulation could be maintained and need for more respiratory support like intubation could be prevented. In need of bag valve mask ventilation and endotracheal intubation, at least two physicians should perform this procedure through video laryngoscopy and oropharyngeal airway.

CONCLUSION

COVID-19 pandemic is the biggest global public health crisis today. No specific treatment has been shown to be effective from the first time it was determined until today. Though public health politics aiming at prevent COVID-19 cases are much more important than developed medical Technologies, both administrators of the countries and hospitals should cooperate with ICU practitioners in order to overcome the difficulties of ICU care. In the light of COVID-19 pandemic and the data obtained from the intensive care follow-up of these patients, the need for intensive care units that are well-organized and have well-trained health professionals has come up once again. Intensive care science has a leading role in the management of such epidemics. The contribution of intensivists dealing with complex organ failures is highly significant in terms of training of health professionals during the planning of these epidemics. While organizing these planning, to support health professionals emotionally, increase motivation by using available communication tools and minimise the fear and anxiety are quite important to prevent burnout.

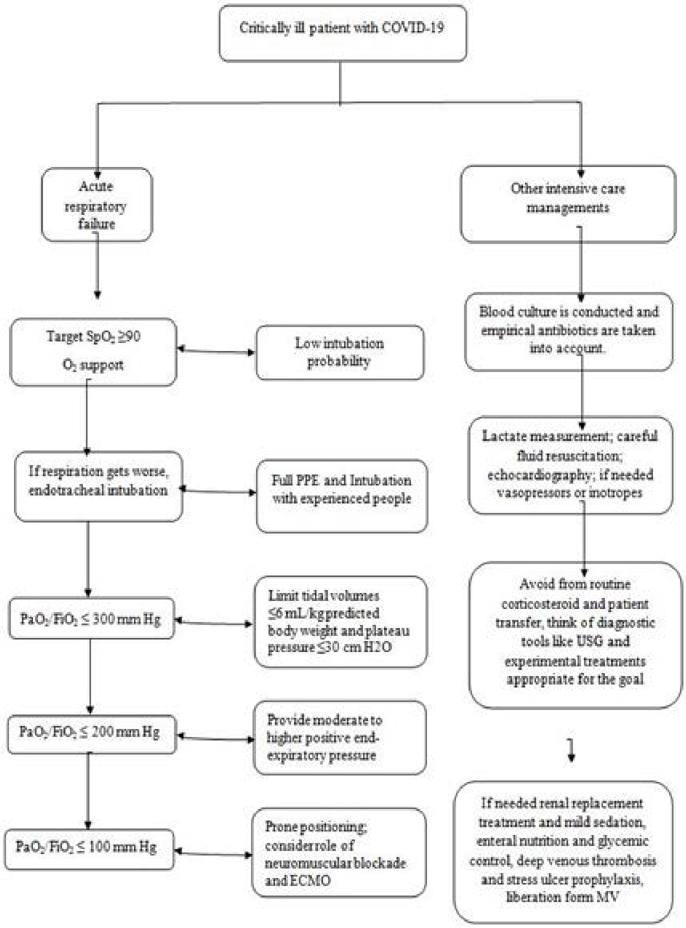

Figure-1: Clinical management of critically ill patients with COVID-19

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